ELEC 677: Topics in Scientific Computing, Spring 2021

1. **Syllabus**:

   - **I Preliminaries**

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     1 The Model Reduction Enterprise / Machine Learning / Motivating Examples
     2 System Theory Sundries: linear, nonlinear, and DAE systems
     3 Model reduction via projection/Interpolatory projections
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   - **II Core Concepts**

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     4 Interpolatory Model Reduction
       a Tangential interpolation
     5 Data-Driven Model Reduction and the Loewner Framework
       a Data-driven implicit projections
       b The Loewner framework
     6 Optimal H2 Model Reduction
       a The iterative rational Krylov algorithm (IRKA)
     7 The AAA algorithm
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   - **III Nonlinear Dynamics**

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     8 a Reduced Basis (RB) methods
       b Proper Orthogonal Decomposition (POD) methods
       c Interpolatory model reduction for nonlinear systems
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2. **Reading material**: Class notes, papers, and selected parts of the book:
   A.C. Antoulas, C.A. Beattie, and S. Gugercin, *Interpolatory methods for model reduction*, Series in Computational Science and Engineering, volume CSE 21, SIAM Philadelphia, 2020.

3. **Homework, grade, credits**: Students will be expected to work on projects which may extend over several weeks. The grade will depend both on the presentation and on the written report.

4. **Course learning outcomes**. Students shall:
   (a) Explore topics in scientific computing and data science;
   (b) Achieve proficiency in setting up and solving complex scientific computing problems;
   (c) Get acquainted with and become proficient in data science from the dynamical systems perspective.

5. **Instructors**: A.C. Antoulas (ECE), *Guest Lecturer*: M. Heinkenschloss (CAAM).

6. **Office Hours**: by appointment through zoom.

7. **Title IX.** Rice University cares about your wellbeing and safety. Rice encourages any student who has experienced an incident of harassment, pregnancy discrimination, gender discrimination, or relationship, sexual, or other forms of interpersonal violence to seek support through The SAFE Office. Students should be aware when seeking support on campus that most employees, including myself, as the instructor, are required by Title IX to disclose all incidents of non-consensual interpersonal behaviors to Title IX professionals on campus who can act to support that student and meet their needs. For more information, please visit safe.rice.edu or e-mail: titleixsupport@rice.edu.

8. **Students with disabilities**. Any student with a documented disability needing academic adjustments or accommodations is requested to speak with the instructor during the first two weeks of class. All discussions will remain confidential. Students with disabilities should also contact Disabled Student Services in the Ley Student Center.